Assistant Type Telephone Set

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An entirely new series of subscriber telephone sets has been developed jointly by Standard Elektrik Lorenz and Bell Telephone Manufacturing Company. With the requirements of several European telephone administrations in mind, several models were designed and tested [1] by a large number of subscribers in various countries during 1956 and 1957. The majority favored the Assistant set shown in Figures 1 and 2.

Figure 1—Assistant set.

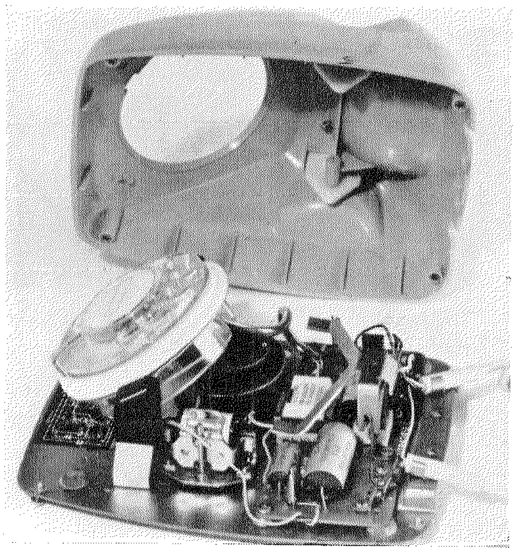


Figure 2—Desk-type subscriber set with cover removed.

1. General Design

For the case, a copolymer of styrene and acrylnitrile combines smart appearance, light weight, and an easily cleanable surface with good impact and scratch resistance. The standard color is grey with ivory mouthpiece and earpiece. The subscriber set is 115 millimeters (4.5 inches) high, 225 millimeters (9 inches) wide, and 200 millimeters (7.9 inches) deep. It weighs 1300 grams (2.9 pounds).

Miniature components are mounted on a printed-wiring board screwed to a metallic base plate, which is fastened to the case by screws. Only the ringer and dial switch do not form part of the printed wiring.

The circuits have been designed for improved performance on all existing feed lines connected to automatic or manual exchanges and to private branch exchanges.

2. Printed Circuit

Most of the wiring is on a rectangular sheet of high-grade glass fiber. The induction coil, gravity switch, capacitors, resistors, varistors, and terminals are automatically assembled and dip-soldered to this board. A 4-wire connector to the dial and a pair for the ringer are also dip-soldered.

The assembled printed circuit is screwed to 4 embossed threads in the steel base plate, which are positioned to support the gravity switch and the board in the region of the screw terminals.

3. Telephone Circuit

To meet the needs of various administrations, 4 different printed-circuit boards are provided.

(A) Circuit with automatic equalization (Western Electric 500 type).
(B) British Post Office Type.
(C) Circuit without equalization.
(D) Bridged circuit (German Post Office).

The printed-circuit board in Figure 3 is the equalized version.

The subscribers set with automatic equalization uses either a ring-armature or a rocking-armature receiver and a conventional transmitter capsule. The circuit includes 2 silicon-carbide varistors. A click-suppressor is mounted on the printed-circuit board.

The circuit that meets the requirements of the British Post Office differs from the equalized circuit in that the 2 matching varistors are replaced by a rectifier stack and a lamp.

4. Induction Coil

The miniature induction coil has about a quarter of the conventional volume. Its small size and weight permit it to be fastened directly to the printed-circuit board by dip-soldering to its wire-type terminals. A special nylon coil former is employed, and the core is of silicon-steel laminations. Its electrical characteristics are comparable to those of the conventional induction coil.

5. Gravity Switch

The gravity switch is also of miniature size and designed for automatic dip-soldering into the printed circuit. It is fixed directly to the base plate by 2 screws. The springs for the 2 make and the 2 change-over contacts are embedded in a plastic compound. A plastic device riveted to the gravity-switch operating arm actuates the spring and at the same time affords protection against dust. Each spring carries twin palladium contacts.

6. Ringer

The single-coil ringer of Figure 4 is a 2-polarity system. The permanent ferrite magnet and the soft-iron core are both contained within the coil.

The permanent-magnet flux path includes the soft-iron core, operating air gaps, armature, and the other pole area. The area of the armature opposite this pole area is large so as to reduce the reluctance of this air gap.

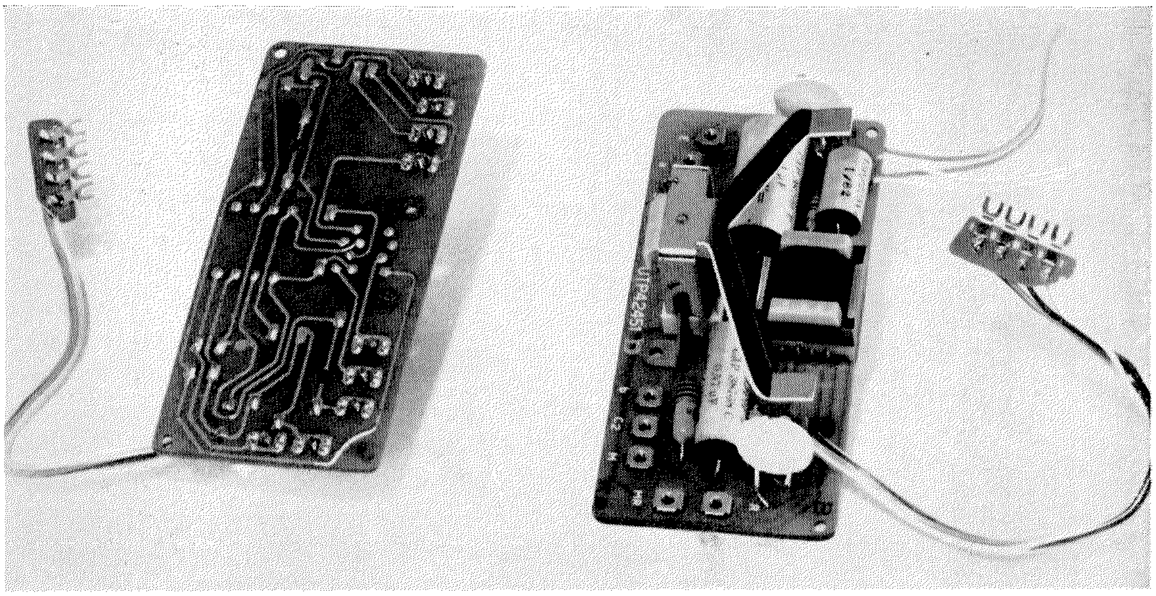


Figure 3—Printed-wiring board equipped with equalizer.

The clapper oscillates between the bell domes and may be laterally biased by an easily mounted spring. A simple knob regulates loudness over a range of about 7 decibels.

7. Dial

The dial, shown in Figure 5, consists of a brass punched base plate on which are mounted the main-spring holder, impulse mechanism, speed regulator, and transparent finger wheel, which are the rotating parts, and the spring nest, finger stop, number plate, and top plate, which are fixed.

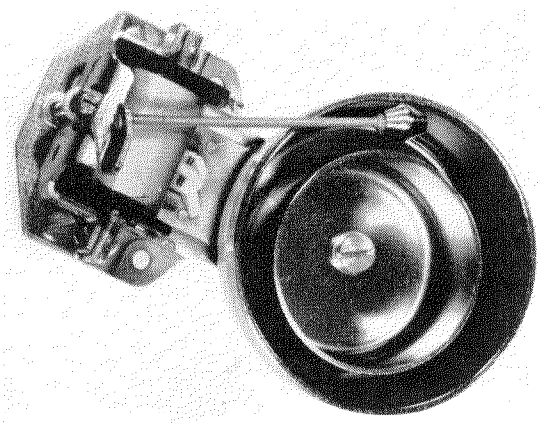


Figure 4—Single-coil 2-polarity ringer.

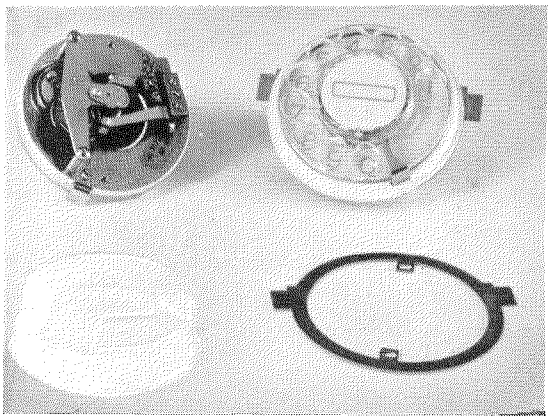


Figure 5—Dial mechanism.

The speed regulator is of the slow-motion type operating at 1000 revolutions per minute. Each of 2 centrifugal weights are controlled by a torsion spring, the tension of which can be adjusted by moving a slider over a graduated sector. Each graduation corresponds to a definite amount of speed variation, and this adjustment can be performed without tools. The regulating action of the centrifugal weights is obtained by the brake effect produced by a bakelised-canvas sector that is part of each weight. The weights rotate in a brass drum.

The impulse mechanism is designed so that the rotation of the speed regulator is started before the impulse cam starts. The impulse contacts are opened by 3 protruding sectors of the impulse cam, which is of the flutter type.

This impulse cam, containing 3 holes for operation with the ratchet springs, is made of polyamide to reduce noise that might be caused by the springs.

As in other designs, the impulse mechanism is provided with a spring clutch. The construction permits easy dismounting of the impulse mechanism.

The helical-type main spring is adjustable and a protecting plate, mounted on the top-plate, prevents any accidental disturbance of the adjustment. The number plate is integral with the outside cover and is of injected acryl.

The dial is acoustically insulated from the base plate by 2 rubber holders and from the case by a polyvinyl-chloride ring, so that noise radiation when dialing is greatly attenuated.

8. Handset

The handset dimensions correspond to recommendations of the Comité Consultatif International Télégraphique et Téléphonique. It is short, thus ensuring a lowered reference equivalent of the sending system and an increase in signal-to-noise ratio. It is shaped to suit the palm and does not tire the fingers. The light weight of the handset causes no fatigue even during long conversations.

To make the transmission advantages of the shortened handset available to as many persons as possible, it is important that the distance between the transmitter and receiver capsules and their angular relations be properly chosen.

Years ago, extensive measurements of the human head were made in various countries [2]. The Comité Consultatif International Télégraphique et Téléphonique selected the head measurements [3] in Figure 6 as average values from which the position of the mouth center was derived. The frequency distribution of the values found in such head measurements [4] as a function of α and δ is shown in Figure 7.

The body of the handset is of a copolymer of styrene and acrylnitrile and is injection molded in one part. Two straight-sided cores that can be withdrawn directly after molding provide for the receiver and the transmitter cavities. The hollow connecting handle is filled with two core pieces that can be withdrawn through the receiver and transmitter cavities.

A disassembled handset is shown in Figure 8. The two capsule supports may differ to accommodate other types of capsules. They prevent acoustic feedback through the hollow handle. These capsules also form defined spaces behind the capsules to improve the acoustic properties of capsules having rear openings for coupling to these air volumes. The capsules are sealed by polyvinyl-chloride rings.

9. Transmitters

The *TMC2046* transmitter capsule in Figure 9 corresponds to the *T1* Western Electric

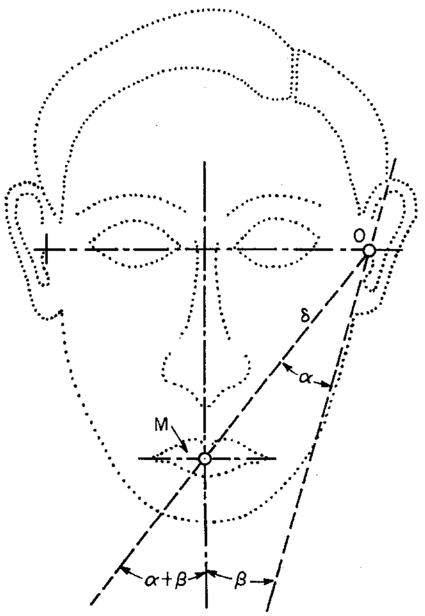


Figure 6—Head standard selected by Comité Consultatif International Télégraphique et Téléphonique. M is the center of the mouth, O is the center of the ear, $\alpha = 22$ degrees, $\alpha + \beta = 34.9$ degrees, and $\delta = 136$ millimeters (5.4 inches).

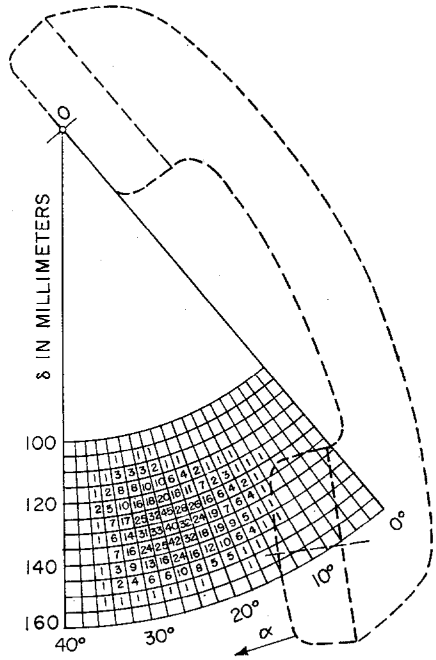


Figure 7—Shape of handset shown on statistical plot of mouth positions with respect to center of ear for 1000 persons.

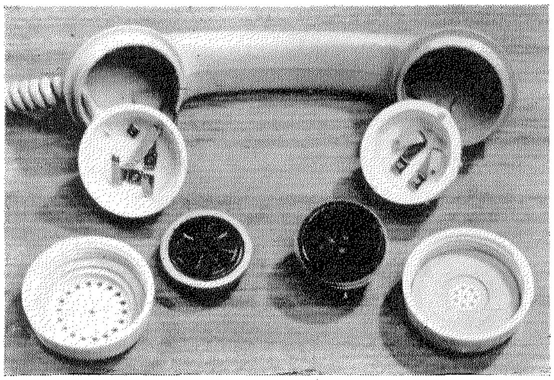


Figure 8—Disassembled handset.

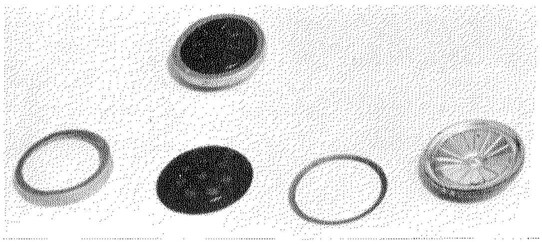


Figure 9—*TMC2046* transmitter capsule.

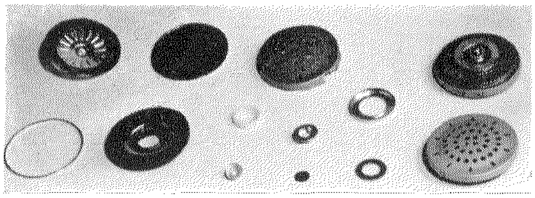


Figure 10—*TMC2047* transmitter capsule.

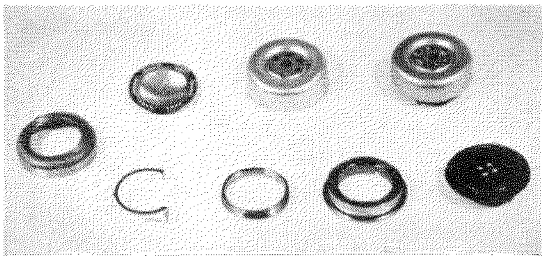


Figure 11—*RCC2687* receiver.

unit. Equalization of response with frequency is aided by three holes in the base that, covered with silk disks of acoustic resistance material, vent the air volume behind the diaphragm into a plastic connecting cup in the handset.

The *TMC2047* transmitter of Figure 10 corresponds to the Western Electric *F1* transmitter in which, however, the damping paper books have been replaced by a metallic separator provided with damping holes. This transmitter is completely sealed against humidity. All transmitters are well protected against corrosion by chromated outside surfaces, a vistanex protecting membrane in front of the aluminum diaphragm, and the use of gold-plated electrodes. Moreover, the electrodes are of spherical shape, thus providing stable performance at various inclinations of the handset.

For use with the Western Electric *500* equalized circuits, the capsules are filled with high-grade pre-aged granular carbon ensuring the high stability of resistance required for adequate operation of the automatic balancing network and for prevention of premature burning with life.

The response of the transmitter capsules are very well equalized with frequency, and approach, in combination with the responses of the receiver, the orthotelephonic response as measured over a 1-meter air path between the human mouth and ear.

The psophometric electromotive-force noise voltage, as measured with the psophometer standardized by the Comité Consultatif International Télégraphique et Téléphonique, the capsules being placed in a soundproof container and supplied with 200 milliamperes, does not exceed 0.02 millivolt.

10. Receivers

One of several suitable types is the *RCC2687A* receiver, which corresponds to the Western Electric U1 ring-armature receiver. As shown in Figure 11, it has a highly coercive alnico circular magnetic system and a dome-shaped aluminum diaphragm that is well balanced between relatively large air gaps by a permendur ring providing a very stable magnetic circuit.

A composite diaphragm permits the central portion to move almost wholly like a piston, making it nearly 100-percent effective.

The shape and level of its response curve make it a high-quality receiver, since it and the transmitter give an over-all response that compensates to some extent for the high-frequency losses of long subscriber lines.

11. Microtelephone Cords

The microtelephone cords are of the coiled type. Their most obvious property is the high extensibility of the coiled part, which can be stretched, by exerting a very slight force, to 5 times its original length. As soon as the stretching force is released, the cord returns to its initial state.

The cords retain the above-mentioned properties, even after repeated pulling and under severe working conditions. The required resilience and elasticity of the material are obtained by a very special production process.

The conductors are made of 7 tinsel wires that are centrally reinforced by a nylon strand, which absorbs the stretching force that otherwise would be exerted on the wires. The conductors are covered with polyvinyl-chloride in such a way as to permit an appreciable sliding of the conductor inside the insulating sleeve. The sleeves are covered by an over-all spirally wound sheeting. The coiled part of the cord has a length of about 300 millimeters (1 foot).

12. Transmission Performance

The absence of automatic equalization permits the *SSB2900A* set to provide more-efficient transmission than the *SSB2900C* on short lines, whereas on long lines their transmission performances are about equal. The reception is weaker than that of the *SSB2900C* and the response is less smooth.

Optimum sidetone suppression is adapted to a 2.5-kilometer (1.6-mile) loop of 23 American Wire Gage cable, but it can be modified for any other loop.

13. Transmission Response

As shown in Figure 12, transmission is measured across a 600-ohm termination of a transmitting system consisting of the subscriber set, subscriber line of either zero or 5 kilometers (3.1 miles) of 26 American Wire Gage cable loop, and a bridged-impedance cord circuit of 2×250 ohms and 48 volts.

The response is referred to 1 volt per dyne per square centimeter as measured with a constant pressure of 30 dynes per square centimeter at the orifice of an artificial mouth before introducing the microphone into the sound field.

14. Receiving Response

The response plotted in Figure 13 is recorded as sound pressure delivered by the receiver capsule to an artificial ear consisting of a calibrated Western Electric *640AA* capacitor transmitter and a 6-cubic-centimeter coupler as recommended by the American Standards Association. The receiver is actuated from a 600-ohm termination across the receiving system, which includes a bridged-impedance cord circuit of 2×250 ohms and 48 volts, a subscriber line, and the subscriber set.

15. Over-All Response

The total or over-all response of two telephone sets connected over two subscribers lines and a central office represented by two bridged-impedance cord circuits, each of 2×250 ohms and 48 volts, is obtained by applying to the transmitting system a constant sound pressure of 30 dynes per square centimeter from the artificial mouth equipment and recording the sound pressure at the receiving system by the artificial ear equipment and level recorder. The

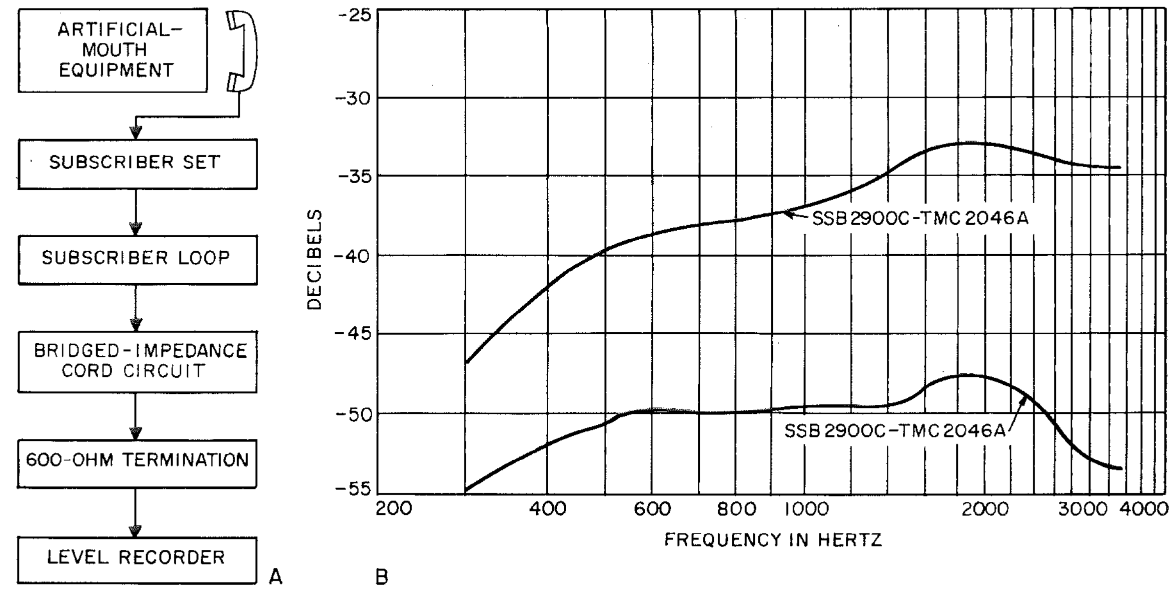
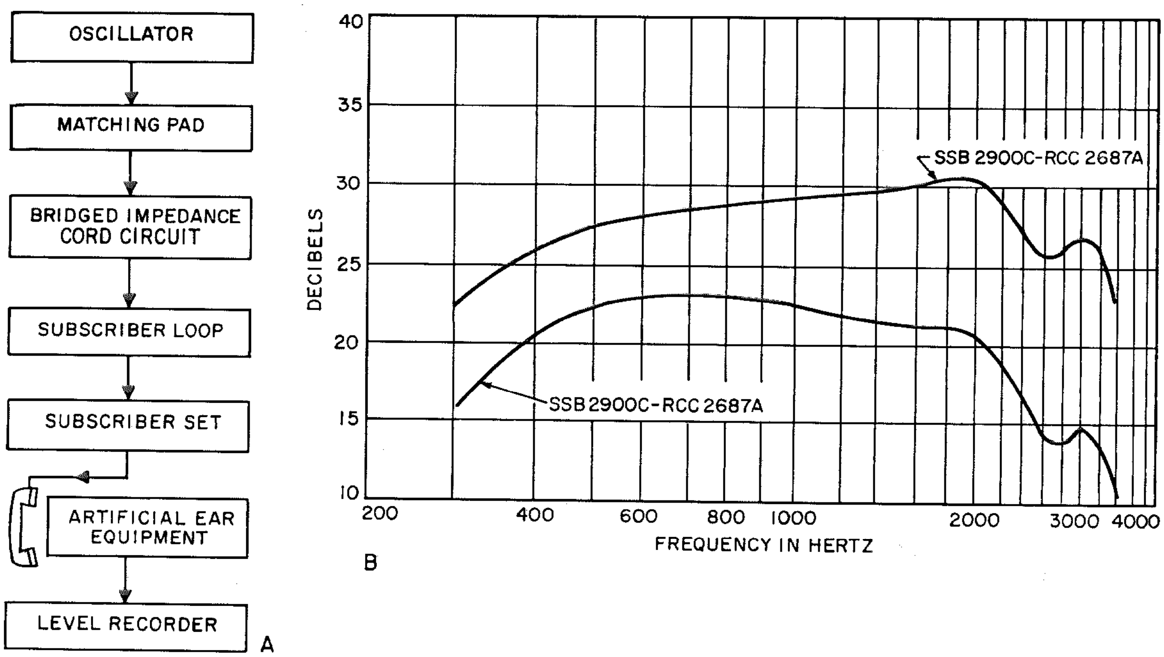


Figure 12—Transmitting response and test circuit. The upper curve is for zero subscriber loop and the lower curve is for an artificial subscriber loop equivalent to 5 kilometers (3.1 miles) of 26 American Wire Gage cable. Response is referred to 1 volt per dyne per square centimeter at the artificial mouth.

Figure 13—Receiving response and test circuit. The upper curve is with zero loop and the lower curve is with an artificial subscriber loop equivalent to 5 kilometers (3.1 miles) of 26 American Wire Gage cable. Response is referred to 1 dyne per square centimeter per square root of 1 milliwatt of available power.



over-all is expressed in decibels referred to 1 dyne per square centimeter per dyne per square centimeter.

16. Wall Set

The *SSB2901* Assistant wall set shown in Figure 15 fills a genuine need for a wall set similar in design to the Assistant desk set. Special attention has been given to standardizing the components of both sets.

The wall set is 185 millimeters (7.3 inches) high, 226 millimeters (9.9 inches) wide, and 76 millimeters (3 inches) deep. It weighs 1400 grams (3.1 pounds).

As in the case of the desk set, the miniature components make possible the use of a printed circuit, which is screwed to a supporting plate. This plate also serves as a support for the dial as is evident in Figure 16.

The housing has been designed so that the

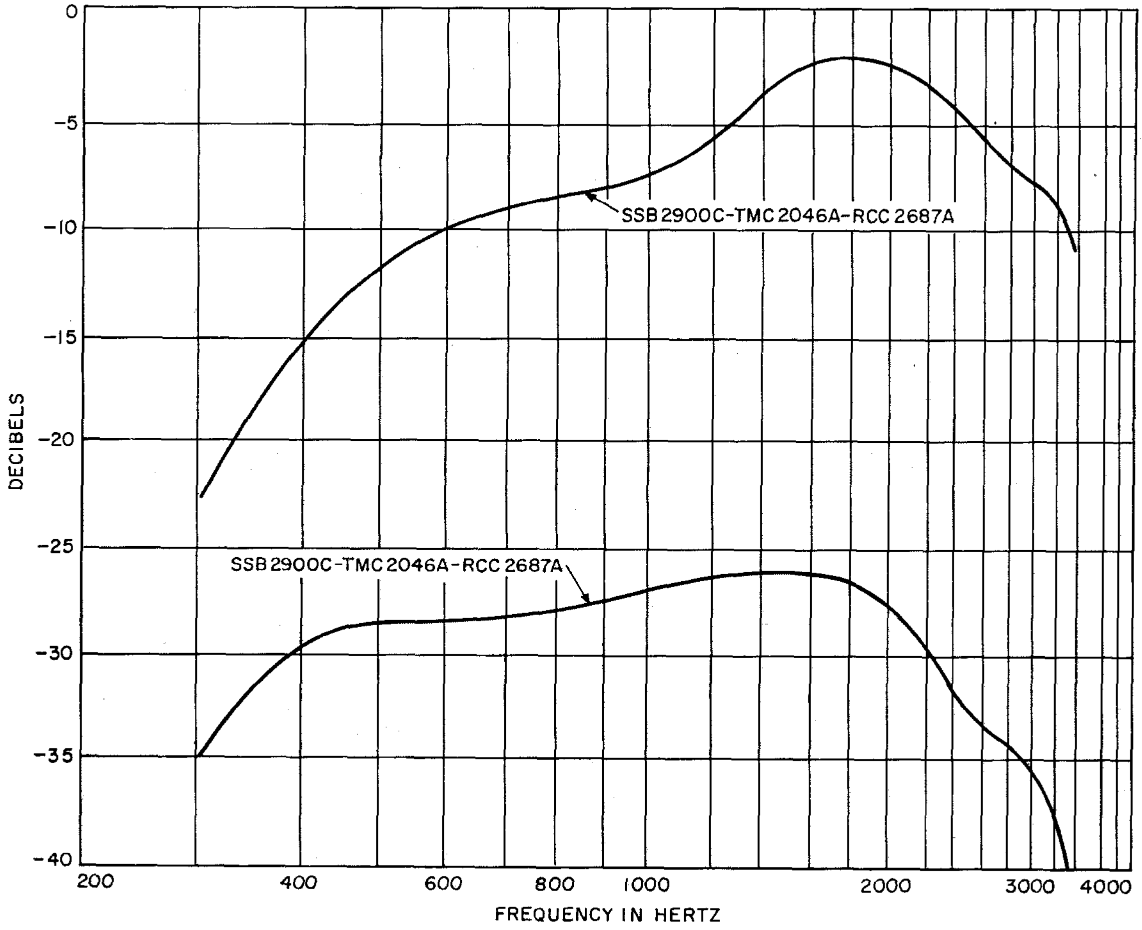


Figure 14—Over-all response using the transmitting and receiving test circuits joining the two bridged-impedance cord circuits to each other. The upper curve is for zero subscriber loops and the lower curve is for two loops or 10 kilometers (6.2 miles) of 26-gage cable. The response in decibels is referred to 1 dyne per square centimeter per dyne per square centimeter.

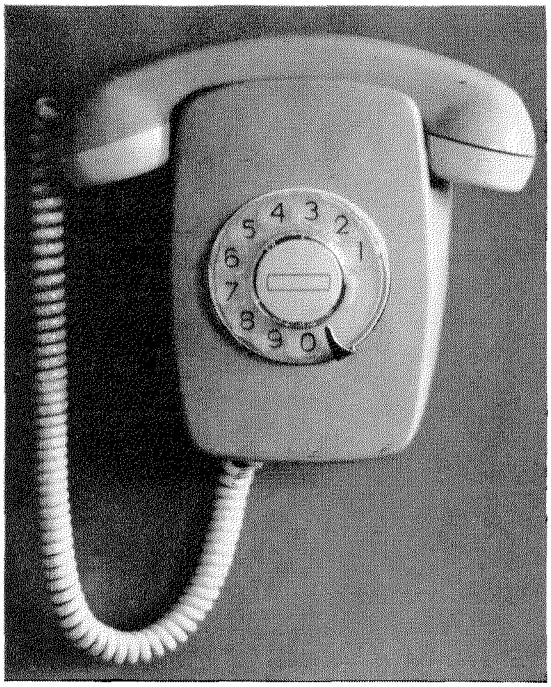


Figure 15—Wall set.

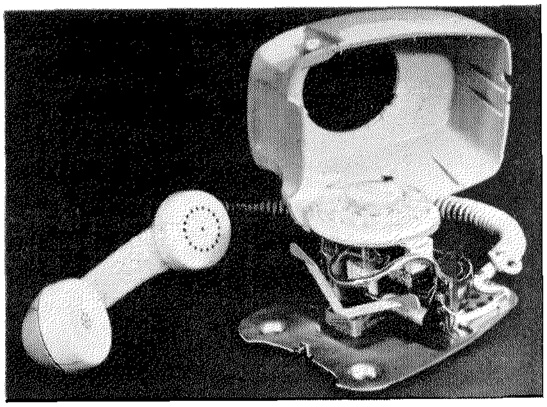


Figure 16—Case removed from the wall set.

handset can be easily suspended from the left- or the right-hand side of the housing without cutting off the line. The indentation in the top of the case (left side in Figure 16) provides for this.

All the essential parts of the desk set, which are the induction coil, dial, ringer, capacitors, resistors, gravity switch, and handset are also used in the wall set.

The various circuits incorporated in the desk set have also been introduced in the wall set and the transmission performance data are identical for both sets.

17. References

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2. W. C. Jones and A. H. Inglis, "Development of a Handset for Telephone Stations," *Bell System Technical Journal,* volume 11, pages 245-263; April 1932.

3. Comité Consultatif International Téléphonique XVe Assemblee Pleniere, Paris, 26–30 Juillet 1949, book 4, page 273.

4. H. J. Lurk, "Ermittlung der Masse eines der Haeufigsten Kopfform angepassten Handapparates unter Zuhilfenahme einer neuartigen. Messapparatur," *Zeitschrift fuer Fernmeldetechnik,* volume 15, number 4, pages 49–52; 18 April 1934.

5. E. E. Mott and R. C. Miner, "Ring Armature Telephone Receiver," *Bell System Technical Journal,* volume 30, pages 110–140; January 1951.

W. Grüger was born on 28 December 1907 at Friedland, Sudetengau (at present under Czechoslovakian administration). In 1932, he graduated from the engineering school at Bodenbach.

After working for an electrical supply company, he joined the design department of Siemens & Halske in 1936. From 1944 to 1946, he was a prisoner of war.

In 1946, Mr. Grüger was employed by Standard Elektrik Lorenz and is engaged in the development of telephone sets.

Henri Van Holst was born on 27 August 1926 in Mainxe, France. He received the degree of civil engineer from the University at Ghent, Belgium, in 1954.

On graduation, Mr. Van Holst joined the acoustical laboratory of Bell Telephone Manufacturing Company. Since 1958, he has been in charge of the group developing subscriber sets.

Fehlerortungen, Ihre Messverfahren in Fernmelde und Starkstromkabeln (Fault-Location Measurements for Telecommunication and Power Cables)

Erwin Widl of Standard Elektrik Lorenz is the author of this book. It is divided into the 12 following chapters, a bibliography, and an index.

1. Introduction
2. Theoretical Principles
3. Types and Effects of Faults
4. Methods of Locating Faults
5. Location of Insulation Faults
6. Location of Breaks in Wires
7. Equipment for Conventional Measurements
8. Location of Crosstalk Faults
9. Location of Internal Reflections
10. Characteristics of Fault Location in Power Cables
11. Examples of Fault Location in a Large Municipal Power Cable Network
12. Comparison of Measuring Methods

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